A BREEDING POPULATION OF THE MALLARD

Hugh Boyd and Bernard King

Summary

THE Mallard breeding population of four reservoirs in north Somerset consisted of 150 to 160 pairs in each of the three years 1957, 1958 and 1959. The recently constructed Chew Valley Lake, which first held breeding ducks in 1954 and which held 106-110 pairs in 1957-59, has been responsible for a great increase in the population, which averaged 60 pairs (range 30-80) from 1948 to 1953, and 120 pairs from 1954 to 1956.

Early nesting Mallard are almost wholly unsuccessful, apparently because of heavy predation due to lack of nesting cover in March. Newly hatched broods are unusually small, averaging 6-7 ducklings. The apparent size of broods changes little before fledging, as small broods seem unusually liable to coalesce.

It is estimated that over a twelve-year period about one-third of the females attempting to breed were wholly unsuccessful, though in several years (notably 1959) there were few failures.

1950 seems to have been a particularly bad year for the production of young, and this was reflected in a small breeding population in 1951. There is a clear linear relationship between the numbers of Mallard present in late August and the numbers attempting to breed in the following spring, suggesting that the population may be nearly 'closed,' despite substantial immigration into the area in autumn and winter. Provisional estimates indicate annual adult losses of 57% and of birds in their first year after fledging of 76%.

This study will be continued. It is suggested that parallel investigations elsewhere in Britain would be valuable and could be made by teams of local observers.

Studies of breeding populations of ducks have flourished in North America during the last twenty-five years. In Britain very few have been attempted. This neglect has perhaps been due to the facts that breeding ducks are relatively scarce over most of the country and that thorough studies require much time and so seem beyond the scope of most bird-watchers. The main purpose of this preliminary report on an investigation which it is hoped can be continued for many years is to suggest that in some circumstances useful results can be obtained by spare-time observers working together without elaborate planning.

The aim of the study is to obtain data on the breeding population of the Mallard in part of North Somerset, to see how and why the size and success of the population varies from year to year. The inquiry is concentrated on the reservoirs of the Bristol Waterworks Company, and in particular on the large Chew Valley Lake (1,170 acres) and Blagdon Lake (440 acres), lying 1¼ miles apart to the north-east of the hills of Mendip and 12 miles south of Bristol. The numbers of ducks of all species found in North Somerset from August to April have been recorded voluminously by many people in recent years, but the breeding population, consisting almost entirely of Mallard, Tufted Duck, and Shoveler in that order of abundance, was largely neglected until 1957.

Methods. The size of the breeding population based on the reservoirs has been assessed from frequent counts from February to August (though few are practicable in June and early July), the numbers of males and females being recorded separately. Wide variations in the numbers seen on different occasions are found. These are partly attributable to errors of observation (such as failure to flush ducks from cover, or confusion resulting from accidental disturbances causing some birds to be counted more than once, or not at all). But the most important cause of variation is the behaviour

of the ducks, which changes with the advance of the breeding cycle. In the simplest case, pairs segregate from a winter flock, each remaining more or less constantly in a limited area, the 'territory.' When the female begins laying she spends a short time each morning at the nest but rejoins her mate at a 'loafing place' for most of the day. When she begins to incubate she remains on the nest almost continuously, with perhaps two short spells off in the morning and evening for drinking, bathing and feeding. The male stays in the vicinity for some time, but normally abandons the female before the brood is hatched and joins other males in flocks which assemble in places offering security for the flightless period of the moult. The simple picture is more or less obscured by seasonal and individual variation in the onset of egg-laying, by the effects of nest losses and subsequent attempts at re-nesting, by diurnal changes in the activities of the birds, by an excess of males in the population, by late emigration of some winter visitors and by the immigration of males prior to the moult. But by mapping the positions of pairs, individuals and flocks, and by noting their undisturbed behaviour, it is possible to estimate the number of pairs attempting to breed within fairly narrow limits of error.

It is a striking, and helpful, feature of the nesting behaviour of the Mallard in North Somerset that almost all the inland breeding pairs in the district spend part of their time at the large reservoirs. The small ponds, streams and drainage ditches, which in other areas would be used territorially, are rarely occupied by pairs in the pre-incubation stage, even though females may later rear broods on them. Pairs nesting up to eight miles away have been seen to return to Blagdon after an early morning visit to the nest. This aggregating behaviour may result from the low breeding density of the Mallard in North Somerset—a little less than one pair to two square miles over the whole area. With so few ducks present the stimulatory effect of territorialism could only be achieved by congregation at the major waters.

No attempts have been made to find nests. A nest census is in theory the best measure of the breeding population. In practice the wide scatter of part of the population makes the task too time-consuming and for the nests in the vicinity of the reservoirs it is most undesirable, because found nests are far too vulnerable to crows and other predators. Thus the survey provides no information on the number of eggs laid, and no quantitative data on egg losses. This deficiency is not very serious, since studies elsewhere have established the likely range and mean of the clutch-size and the (relatively small) extent of losses due to infertility.

The collection of data on broods is an essential requirement. The needs are to find how many broods are hatched, the mean brood-size on reaching the water and the losses before fledging. Observations distinguishing only between newly-hatched, partly grown and nearly full-grown broods seem sufficient to estimate average production for a successful female. Determining the number of broods brought to the water is very much more difficult. Direct observations normally yield too low a figure, since some females are adept at concealing their broods. Late evening has been found to be the best time for seeing young ducklings which then emerge most freely into open water.

The breeding population from 1957 to 1959. During each of the last three seasons it appears that 150-160 pairs of Mallard have been based on the

Bristol reservoirs—106 to 110 pairs on Chew Valley, 30 to 36 pairs on Blagdon, 11 to 14 on Barrow Gurney and 2 or 3 on Cheddar. At the same time between 50 and 100 pairs have been present elsewhere in North Somerset (though the estimate of 55 pairs in this category in 1959 is the only one in which much confidence could be placed). This apparent stability of the reservoir population is remarkable.

The population from 1948 to 1956. For the years before 1957 the number of potential breeding pairs can only be estimated from sex-ratio counts made incidentally by various people, these counts being less frequent than in recent years and not necessarily made at the most suitable times. There were too few records before 1948 to allow even this rather unreliable method to be used. The estimates for 1948 to 1956 are set out below:

TABLE 1. Numbers of pairs of Mallard estimated to have been based on the Bristol reservoirs from 1948 to 1956.

	Chew Valley	Blagdon	Barrow Gurney	Cheddar	Total (to nearest ten pairs)
1948	—	50	14	15	80
1949	—	35	15	12	60
1950	—	30	17	10	60
1951	—	13	2	12	30
1952	—	34	10	22	70
1953	—	35	18	8	60
1954	25	40	10	6	80
1955	40	45	25	9	120
1956	55	80	20	7	160
mean 1948-53 ..	0	33	13	13	60
mean 1954-56 ..	40	55	18	7	120
mean 1957-59 ..	108	33	13	2	160

The most striking feature of these figures is of course the emergence and growth of the Chew Valley Lake population from 1954 (25 pairs) to 1957 (110 pairs). The construction of this large lake, with a shallow shelving shore around most of its $7\frac{1}{2}$ mile perimeter, has been of immense benefit to wildfowl and has nearly doubled the Mallard breeding population of the district (120-130 pairs in 1950-54, 260 in 1956, 220 in 1959).

The boom at Chew Valley has coincided with the eclipse of Cheddar reservoir, never really suitable for Mallard (as its banks are concrete-lined) and rendered almost untenable by dinghy-sailing. Barrow Gurney and Blagdon seem to have retained populations of a pre-Chew Valley level, after unusually large numbers in 1955 and 1956.

Only in 1951 of the seven years 1948-1954 did the population of the established reservoirs appear to depart widely from the average. The marked drop in 1951, affecting Blagdon and Barrow Gurney, seems to have been due to very poor breeding success in 1950, the numbers present in the late summer of 1950 and throughout the subsequent winter, being unusually low.

Records of broods seen, 1957 to 1959. The first dates on which Mallard ducklings have been seen at Chew Valley Lake in the last three years have been 25th April, 25th May and 21st April. These are very late, that of 1958

quite exceptionally so. The reason seems to be that early nesting attempts in the vicinity of the reservoir are doomed to failure because of the comparative scarcity of good nesting cover in March and the abundance of crows.

The latest newly-hatched broods have been seen on 11th July, 10th August and 3rd July. Thus hatching is spread over eleven weeks, with a peak about 20th May in 1957, in mid June, 1958, and late May, 1959. These dates, like those of the first broods seen, are unexpectedly late. Few broods are seen at Blagdon, chiefly because there is an abundance of cover for them at one end, while nests elsewhere are mostly unsuccessful.

Records of brood-size are assembled in Table 2. The numbers of broods included are small, because attempts have been made to eliminate repeat records of the same brood in any one of the age-classes. The average size of newly-hatched broods is exceptionally low. In Holland Eygenraam (1957) reported day-old broods to average about 10.5, and the mean of broods in their first week to vary from 7.44 to 9.65 in different years. (The Somerset data are too few for useful comparison between years.) The scarcity of broods of more than 10 ducklings seems to be a purely local phenomenon.

TABLE 2. Brood-sizes of Mallard at Chew Valley and Blagdon Lakes, 1957-59.

Mean brood size	No. of broods	No. of duck-lings	Brood size												
			1	2	3	4	5	6	7	8	9	10	11	12	over 12
First broods															
recently hatched 6.1	59	414		2	5	2	7	10	11	6	4	7	1	3	1 of 14
partly grown 6.3	57	359	1	3	4	5	11	6	6	6	9	2	2	1	(17, 19)
well grown 6.8	160	1087	1	7	12	11	18	23	16	25	21	16	5	5	(15, 16, 17, 18)
Re-nests															
recently hatched 6.9	38	263	1	1		4	8	5	2	8	4	2		1	13, 15
partly grown 6.6	7	46			1	2	1				1	1	1		
well grown 5.6	22	122	2	1	3	2		6	2	3	3				

At Slimbridge, only 40 miles north-east, where the average clutch-size is 13.3, the mean size of new broods is more than 10. Perhaps the low output in Somerset results from few of the ' first broods ' emerging from ' first clutches'.

The recorded increase in the size of first broods with age is an apparent absurdity often found in American studies, though not in the Dutch one. It is probably due partly to the greater ease of counting well-grown broods and partly to a tendency for broods to coalesce—shown clearly by the emergence of ' monsters ' of 16 to 19. Mixing of broods seems to occur more readily at Chew Valley than is usual. More detailed studies of brood-size in Somerset, and elsewhere in Britain, are badly needed, for these preliminary results differ widely from those obtained in Holland, where the proportions of both large (9 and over) and very small (1 or 2) broods were found to decrease markedly with age.

For the purpose of a population study the most important piece of information about broods is the average number of ducklings reared by a successful female. From the combined ' first broods ' and ' re-nests ' of Table 1 this appears to be about 6.6, a figure within the range of 6.02—6.91 reported in different years by Eygenraam (*loc. cit.*) and justifying the assumption that there is no major difference between Somerset and Dutch Mallard in this respect.

Total production of young. In 1957, the year in which most field-work was done, observations suggested that 25 females brought first broods to the water at Chew Valley and that a further 15 were later successful, indicating that only 40 of the 100-110 females attempting to breed succeeded in hatching young. But this figure must be a minimum, since it is very unlikely that all broods were seen.

Eygenraam (*loc. cit.*) used an indirect method of estimating the proportion of unsuccessful females, based on the sex-ratio of adults in June, which indicated that in each of two years 20-24% of Dutch Mallard females were unproductive. This method cannot be used for the Bristol reservoir population, because of the influx of " foreign " males in late May.

From sex-ratio counts in August it appears that most of these immigrants probably leave again soon after regaining the power of flight. Assuming this to be so, the only method so far devised for estimating the production of young at the Bristol reservoirs is to subtract the number of adults present in the nesting season from the highest total count in late August. If this estimated production is then supposed to correspond to six juveniles for each successful female, a figure for the latter is obtained. The method is very crude, since in late August some females are moulting and probably not counted, while juvenile dispersal is probably under way, perhaps involving immigration as well as emigration. The results of this procedure are set out in Table 3. In 1957 and 1958 about half the resident females appear as successful (compared with one-third to one-half estimated from observations of broods in 1957). 1959 was generally believed to be a very good year for Mallard production in most parts of England, so that the suggestion that nine-tenths of the Bristol reservoir Mallard reared some young is not wholly implausible.

TABLE 3. Estimated breeding success in relation to population size at the Bristol reservoirs 1948-59.

Year	Estimated breeding population (pairs)	Highest August count	Apparent Production	Proportion of females breeding successfully
				%
1948 ..	80	270	110	23
1949 ..	60	360	240	67
1950 ..	60	170	50	13
1951 ..	30	360	300	167
1952 ..	70	650	510	122
1953 ..	60	460	340	95
1954 ..	80	600	440	91
1955 ..	120	780	540	75
1956 ..	160	810	490	50
1957 ..	150	750	450	50
1958 ..	160	800	480	50
1959 ..	160	1180	860	90
Total ..	1190	7190	4810	67

For the earlier year the reliability of the estimates is even lower. The suggestion that in 1951 and 1952 more than 100% of females were successful, while numerically absurd, is not biologically impossible, if the average brood reared in those years was well above six, though in the present case it seems more likely to be attributable either to under-estimates of the breeding population or to early autumn immigration. The estimate that over the whole twelve-year period the average proportion of successful females was two-thirds is rather below that of Eygenraam for Holland, but well above that for some Canadian studies.

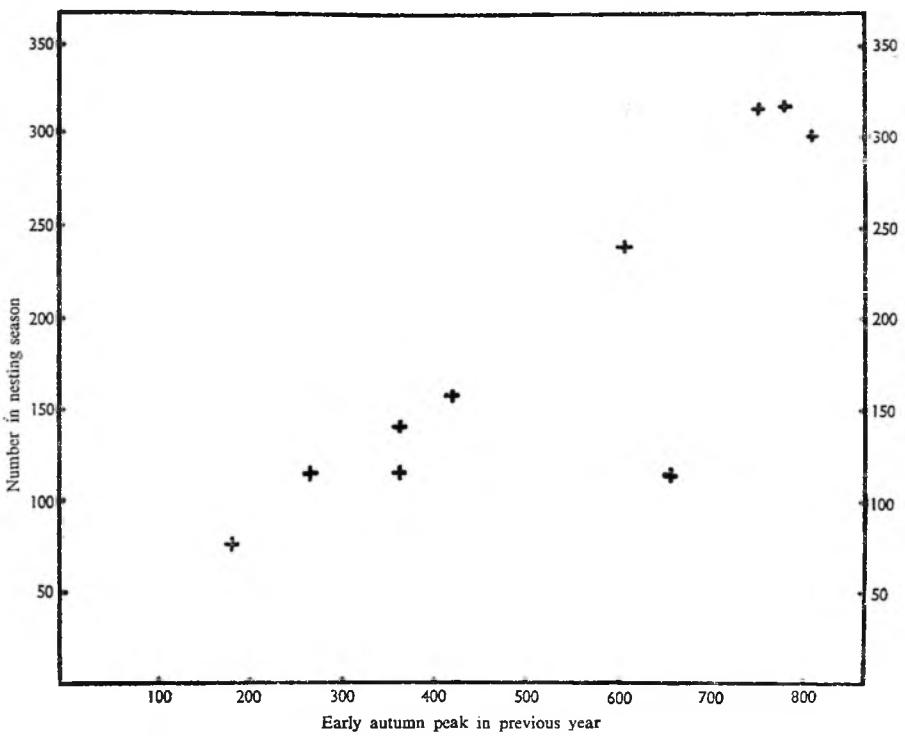

FIGURE 1. Relation between numbers of Mallard on North Somerset reservoirs in the nesting season and numbers in the preceding August, 1949-59.

Self-maintenance by the population. The comparison of the August numbers with those in the following spring is of great interest. Figure 1 shows that for nine of the ten pairs of observations available (data of Table 3 again) there is a close approximation to a linear relationship, so that the size of the nesting population is apparently directly related to the numbers present in the previous August. This suggests that the losses suffered between August and April, whether by death or emigration, constitute a nearly constant fraction of the August numbers. Confirmation of this finding by a long series of more reliable spring and autumn counts would be of great theoretical interest.

The data of Table 3 can also be used to give an estimate of the average losses during the year, if information from Mallard ringed elsewhere in England is utilised. Boyd (unpublished) has found that about nine-tenths of the losses of British-breeding Mallard occur between August and April, and that the mortality of birds in their first year after fledging is greater than that of older birds by a factor of 1.32. Applying these corrections to the apparent losses between August and April, it appears that the annual losses of Somerset adults have averaged about 57% and those of young birds 76%. These losses may include emigrants unreplaced by immigrants. This estimate of adult losses is rather above the mean rate of adult mortality found in a variety of studies in Europe and America. The apparent first year mortality is comparatively low.

It appears that changes in the number of autumn and winter visitors to the Bristol reservoirs may normally be of little significance to the local breeding population, although in 1956 the increase in the breeding birds of Chew Valley lake was very probably enhanced by some of the hard weather immigrants of February remaining with the summer residents.

Discussion. The tentative results of this unfinished study are not startling. Is there any reason for supposing them to be of more than local interest? The writers believe there are at least two good reasons. First, the simple assumption that the late August numbers are an index of the production of young, though theoretically open to criticism on many grounds, seems in practice to be valuable, because it seems unlikely that if the population at that date was really highly heterogeneous it would give rise to a relationship with the estimated breeding population as clear and consistent as that indicated by Figure 1. If similar observations elsewhere produce similar results, it would seem possible to carry out long term studies of local breeding populations with a remarkable economy of effort, the requirements being a series of sex-ratio counts in the spring, and of total counts in August and September.

Second, the brood counts suggest marked differences in early brood-size and in the incidence of duckling losses between the Somerset Mallard and those studied by Eygenraam and his collaborators in Holland. The latter collected better data (ageing broods more precisely than has yet been done as a general practice in Somerset), so that some of the discrepancies in the results may not reflect real differences, but they suggest that widespread sampling in Britain might produce valuable results.

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